



# Welcome to the Oil & Gas and Petrochemical Industry Track



# The O&G and Petrochemicals Team

## Global Industry Principals



Cindy Crow  
(Houston)



Russell Hebert  
(London)



Craig Harclerode  
(Houston)

## NA Industry Champions



Brian Harclerode – FSE












Ken Startz - SE



Stephen Reynolds - COE

# A Big Thank You to our Speakers!

Time Slot	Company(s)	Title
9:00 - 9:30	 OSIsoft.	“Smart”, Configurable OT Infrastructure
9:45 -10:15	 EQT Midstream	Enabling Reliability Centered Maintenance
10:45 – 11:15		Blowout Preventer Monitoring
11:30 – 12:15	 noble energy	Corporate PI AF + Geospatial Analytics
12:15 –2:15	 OSIsoft.	Lunch – Midstream Users Group Kick Off
2:15 – 2:45		Real-Time Operations on Shell Prelude FLNG
3:00 – 3:30	 Chevron	CBM and Smart Monitoring of Frade FPSO
4:00 – 4:45	 MOL	Opportunity Crudes/IOW & Advanced Analytics
4:45 – 5:15	 devon	Enabling the Journey of Operational Excellence

3

# Oil & Gas and Petrochemicals PI User Groups

Join to discuss best practices, white papers, share news, and exchange ideas.

## Objectives:

- Identify Best Practices
- Share knowledge and ideas across our industry
- Foster communication with OSIsoft regarding Industry needs

104  
Members

Customer run,  
customer led,  
OSIsoft assisted

This is NOT an avenue for sales presentations or marketing

Want to opt in?

<https://pisquare.osisoft.com/groups/midstream>

Or contact [jsirois@osisoft.com](mailto:jsirois@osisoft.com)

Upstream – 2017/18

Hydrocarbon Processing Industry (HPI) 2017/18



Have questions?

- [jsirois@osisoft.com](mailto:jsirois@osisoft.com)
- [ccrow@osisoft.com](mailto:ccrow@osisoft.com)
- [charclerode@osisoft.com](mailto:charclerode@osisoft.com)
- Visit the PI Square Booth





# Enabling Transformative Change & Business Value with IIOT, Advanced Analytics, & Big Data

Craig Harclerode  
Global O&G/Petrochemicals IP



# Important Things to Consider When Implementing IIoT, Advanced Analytics, and Big Data

CXO INSIGHTS

## Important Things to Consider When Implementing IIoT, Advanced Analytics, and Big Data

By Craig Harkins, Global CXO Business Development Director, OSIsoft

When it's all said and done, IIoT, advanced analytics, and big data (collectively referred to as advanced analytics) will drive the success of your organization. The success of your organization will depend on how well you implement these technologies. The success of your organization will depend on how well you implement these technologies. The success of your organization will depend on how well you implement these technologies.

Successful implementations leverage fit for purpose technologies to address the unique characteristics and challenges of time series data and real time analytics.

There are four considerations to keep in mind when implementing IIoT, advanced analytics, and big data. These considerations are: 1. Data integration, 2. Data storage, 3. Data processing, and 4. Data visualization. Each of these considerations is critical to the success of your organization.



My Perspective on Doing Things Differently

1. They did not forget that it is about delivering business value, supporting a business strategy, and addressing a problem. In other words, not just for the sake of the technology, but for the sake of the business.
2. They started the journey of creating an operational data infrastructure (ODI) as a foundational element of an enterprise IIoT, advanced analytics, and big data strategy. If you focus on the technology first, you may have a hard time in the cloud, use resources and process information that will create everything from sensor data to complex models. Successful implementations leverage fit for purpose technologies to address the unique characteristics and challenges of time series data and real time analytics.
3. The ODI data infrastructure includes the secure access of associated data to be aggregated across a portfolio of ODI data sources including primary and cloud-based IIoT sensors, distributed and centralized logging, smart sensors, batch of streams, and data lakes, quality assurance, high fidelity time series retrieval, and contextual representation to the IIoT data or "OT" data of sensors, which structure has been modeled

by reputation. Lastly, the ODI data infrastructure needs to be a hybrid architecture with an integrated experience and cloud architecture to enable flexibility and maintain ease of use in technology and complex control systems.

2. Write the OT data infrastructure, their created configurable smart asset model templates that can be leveraged to enable the operational control of the entire manufacturing plant. These smart asset models are designed to be used in a variety of ways, such as to perform offline data analysis such as efficiency analysis, ODI to offer a rich set of analytics to improve higher level advanced analytics and big data. As these models serve to the edge, the smart asset models can be used to control and support all these layers of the edge, to the ODI data infrastructure, to support higher level analytics, and supporting being able to support asset operations at a recent user's location.

4. They realized what and where analytics are performed between the OT data infrastructure, advanced analytical platforms, and big data tools to reach OT analytics due to the information to smart assets providing to other the analytical environment to higher level analytics. Capabilities such as exchange and plug efficiency, energy utilization, and trends in advanced ODI can and should be done in the ODI infrastructure closer to the source in the higher level platforms and be made available to users managing data efficiency to leverage across multiple end users, and allow to operational. Performing OT analytics in the ODI data infrastructure will also enable the integration of analytics to the edge of the line.

5. They bridged OT IT by use of the IIoT data needed to be connected by the use of an integrated layer that connects, captures, stores and retains (C4S) operational data so that it can be accessed in operational IT systems. These data can be accessed in operational IT systems. These data can be accessed in operational IT systems.

As a result, OSIsoft, one of the world's largest computer manufacturers, has adopted a new approach to address data from its 70 plants in business customer applications to planning energy. In Canada's utilities, the same data has been used to improve the data processing from the data to the data. The data processing from the data to the data.

ENERGY SPECIAL  
**CIO Review**  
The Navigator for Enterprise Solutions  
OCTOBER 14, 2016 CIOREVIEW.COM

IN MY OPINION  
NICK FERUGINI,  
CO,  
CURRENT, POWERED BY GE ENVISIO

CIO INSIGHTS  
KARL POPHAM,  
MANAGER OF BERKING  
TECHNOLOGIES & ELECTRIC  
VEHICLES, AUSTIN ENERGY

CIO INSIGHTS  
RANDEE JENNINGS,  
SUNCO,  
ONS LSC

YANNI CHARALAMBOUS,  
VP & CO,  
OCCIDENTAL PETROLEUM  
CORPORATION

**TAS**  
The Benefits of a  
'Modular' Future  
for Data

By Craig Harkins, Global CXO Business Development Director, OSIsoft

“ Successful implementations leverage fit for purpose technologies to address the unique characteristics and challenges of time series data and real time analytics ”

# #1

## They Used the “4 M Approach”....

### Make Me More Money



# The MOL Story

## A Journey with IIOT, Advanced Analytics, & Big Data

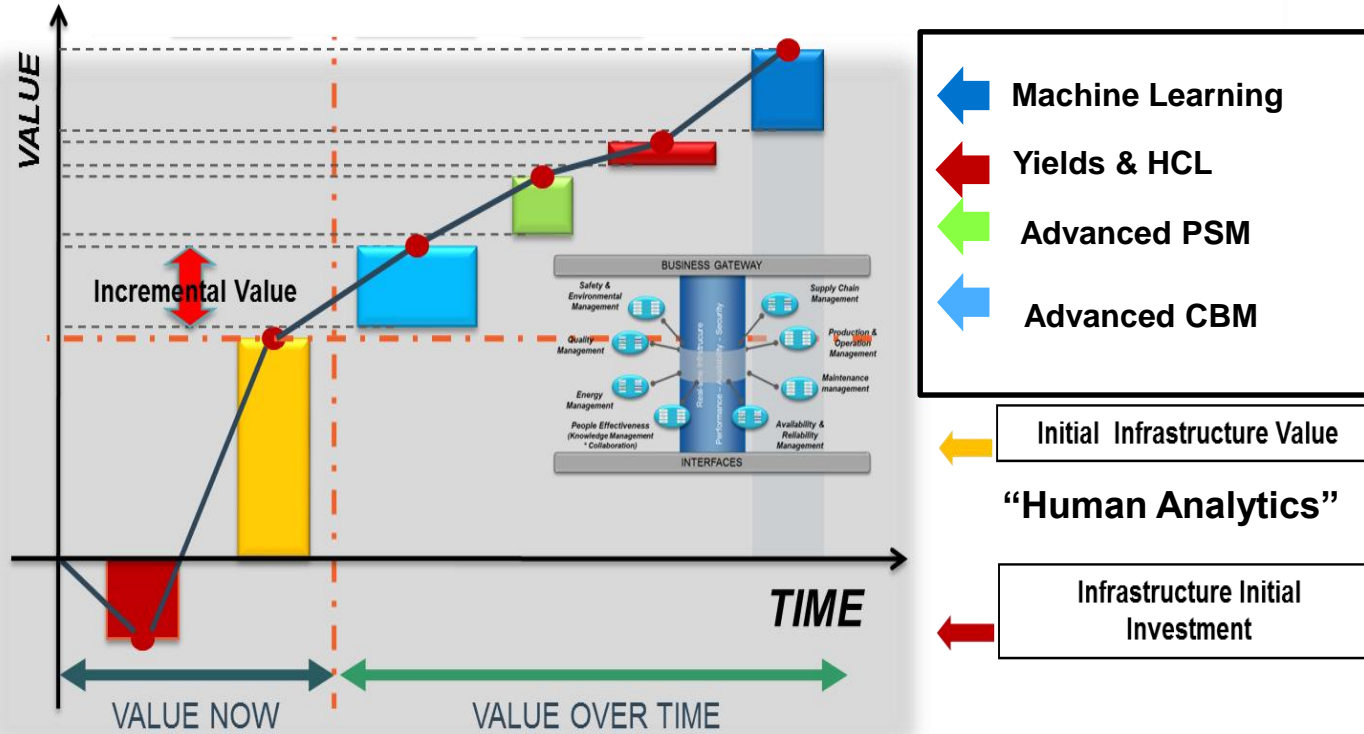
**\$1B EBITDA enabled by Strategic use of the PI System and PI AF as a smart OT Data Model**



# #2

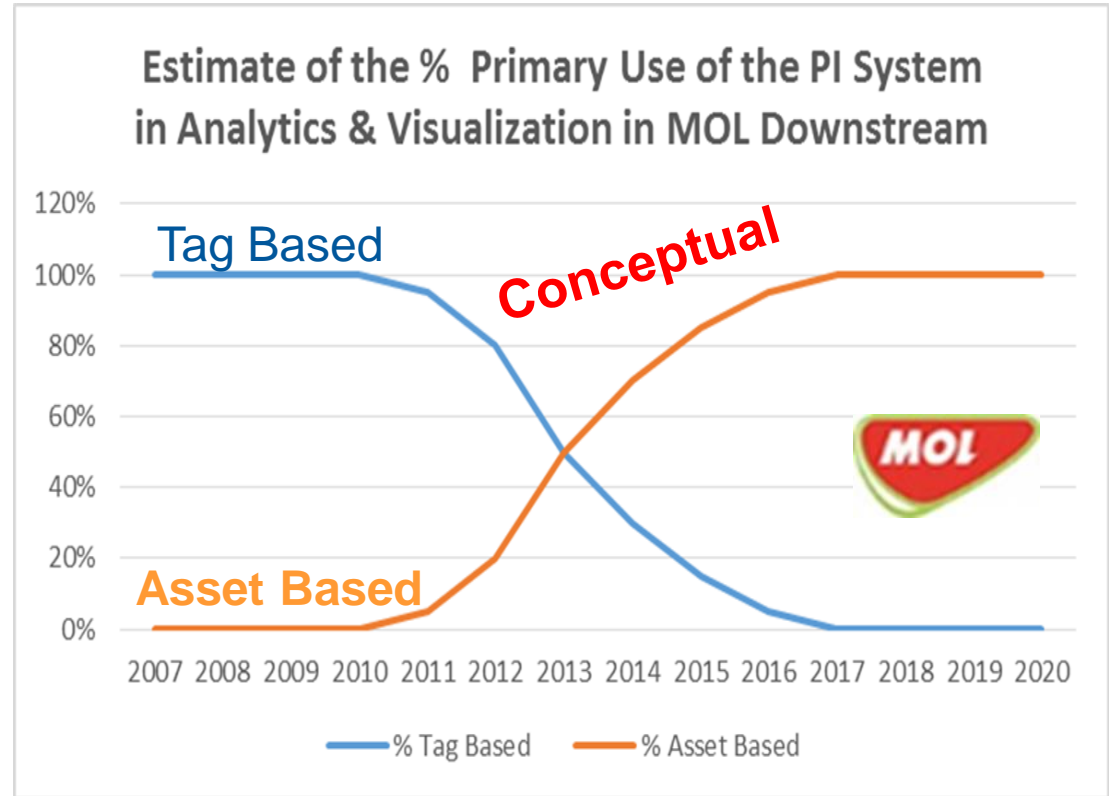
They Focused on the journey of Building  
A “smart” OT Analytical Foundation...first

# An Infrastructure Investment Approach - "OT Data Utility"

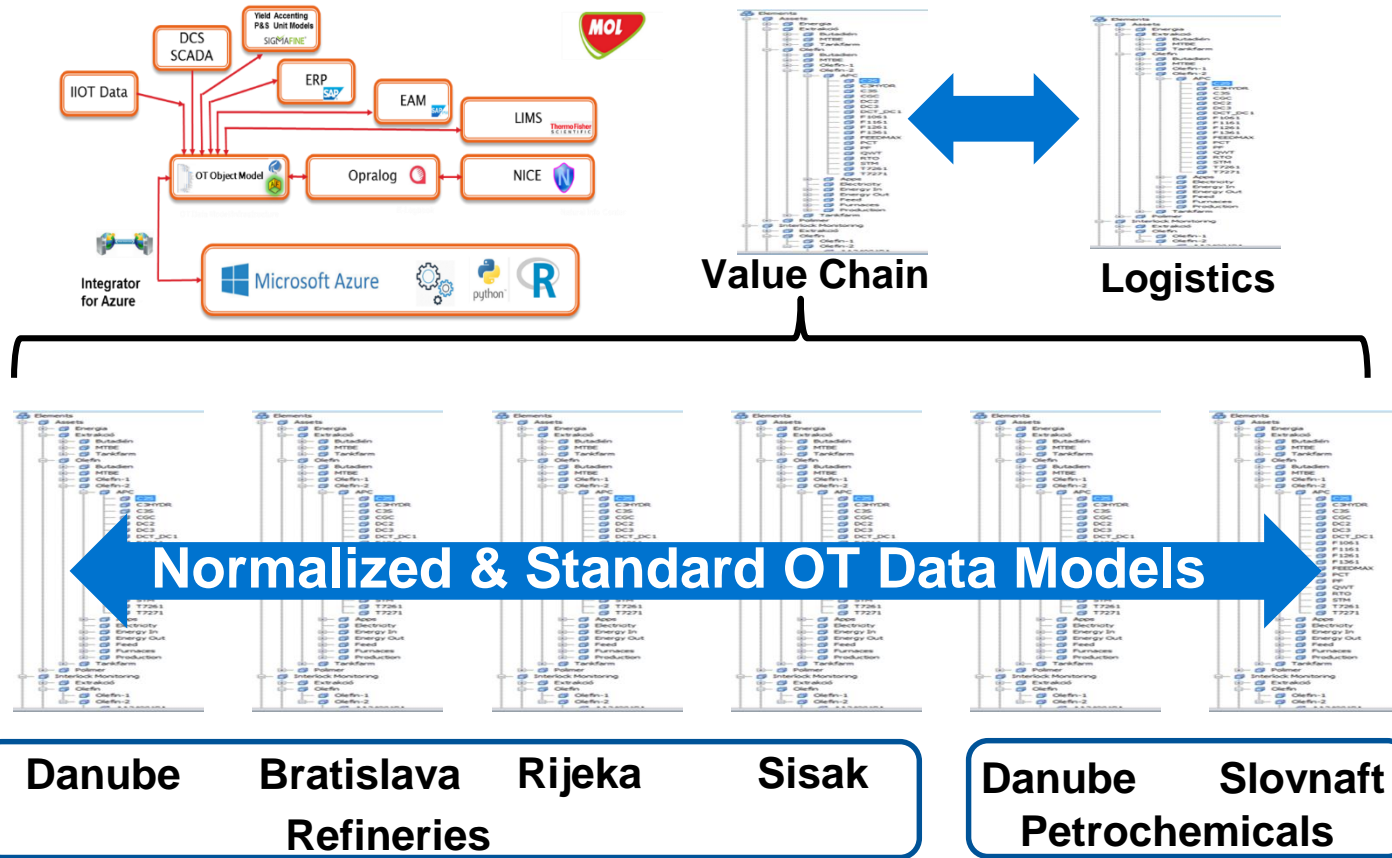


# Moving to PI AF is a Vision and a Journey.....”Just do It!”

- **Start PI AF with a key business initiative** and build, capability, momentum and awareness;
- **Market PI AF vision**, capability, and value to leadership with **alignment to strategic initiatives**;
- Leverage PI AF Jumpstarts, OSIssoft consultation, PI AF templates, SIs, etc. to **lower the barriers to PI AF use**;
- **Once PI AF critical mass** is achieved, adoption will accelerate and be seen as **transformative and strategic**;
- **MOL sees PI AF as enabling** to many PI System capabilities like PI Coresight, PI Connectors, Integrators, etc.;



# MOL Downstream Integrated Smart OT Data Model



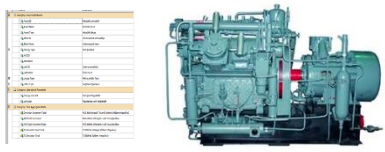
**Danube Bratislava Rijeka Refineries**

**Danube Slovnaft Petrochemicals**

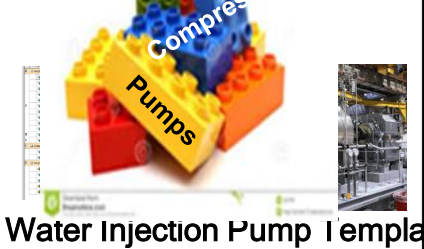
# #3

**They created & leveraged  
OT Configurable smart asset objects**

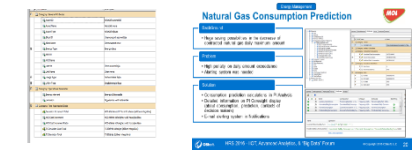
# Smart Asset Objects – Configuring the Smart OT Infrastructure-Smart FPS



Compressor Template



Water Injection Pump Template



Smart Application Template

Physics Based Attributes  
 Meta data  
 Sensors/Time Series  
 Performance Curves  
 Knowledge & Experience  
 Health Index  
 Limits  
 KPIs  
 SOP (.pdf)  
 Events  
 Notifications  
 Etc.

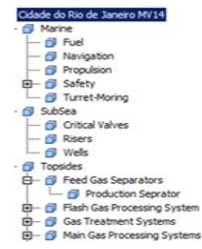
**Digital Twin or "Avatar"**



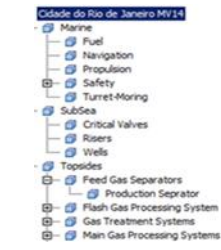
Physical FPS #1



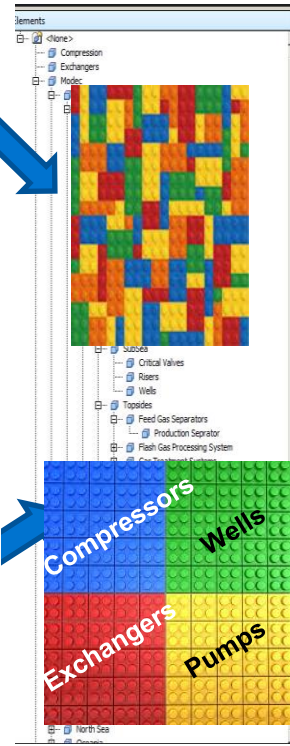
Physical FPS #2



Digital FPS #1

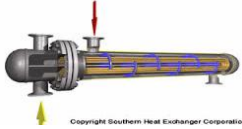
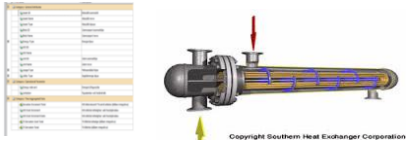


Digital FPS #2



Smart OT Infrastructure

# Smart Asset Objects – Configuring the Smart Refinery OT Infrastructure

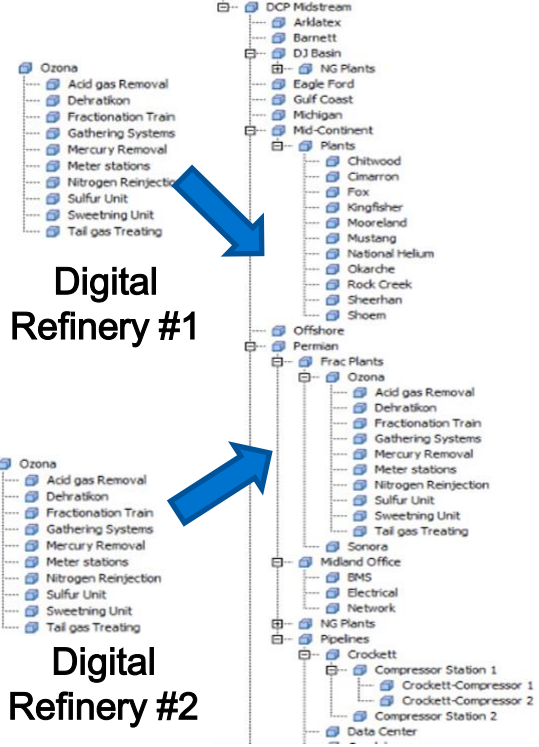


Copyright Southern Heat Exchanger Corporation

Exchanger Template



Physical Refinery #1



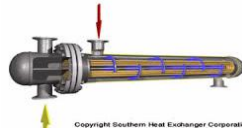
Digital Refinery #1

Digital Refinery #2

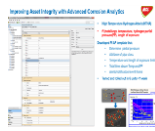
Digital Enterprise



Tower Template



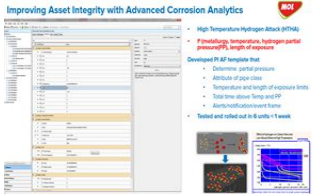
Copyright Southern Heat Exchanger Corporation



Physical Refinery #2



Pump Template

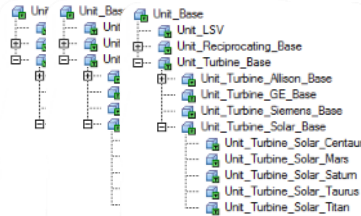


Application Template (eg. HTHA Corrosion)

# TransCanada Anomaly Detection & Predictive Analytics

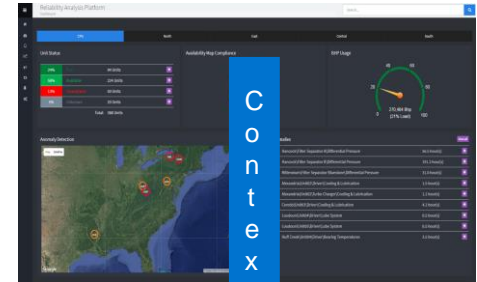


## Physical Compressor Stations



Digital Compressor Stations

Exception based KPI Dashboard system



Contextual Drill Down

Asset	Location	Status
Asset 1	Location 1	Operational
Asset 2	Location 2	Operational
Asset 3	Location 3	Operational
Asset 4	Location 4	Operational
Asset 5	Location 5	Operational
Asset 6	Location 6	Operational
Asset 7	Location 7	Operational
Asset 8	Location 8	Operational
Asset 9	Location 9	Operational
Asset 10	Location 10	Operational



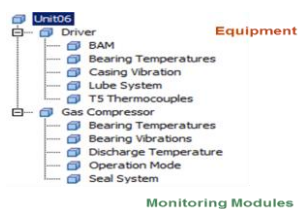
Centrifugal Compressor Templates

Asset	Location	Status
Asset 1	Location 1	Operational
Asset 2	Location 2	Operational
Asset 3	Location 3	Operational
Asset 4	Location 4	Operational
Asset 5	Location 5	Operational
Asset 6	Location 6	Operational
Asset 7	Location 7	Operational
Asset 8	Location 8	Operational
Asset 9	Location 9	Operational
Asset 10	Location 10	Operational

Availability	Performance	Quality
<b> downtime</b> ✓ Event Frames ✓ Downtime classification ✓ Planned vs. unplanned ✓ Maintenance data	<b> runtime</b> ✓ Event Frames ✓ RACR ✓ Horse power usage ✓ Efficiency	<b> anomaly detection</b> ✓ Sensor data behavior based on historical normal ✓ Oil analysis ✓ Equipment analysis reports
<b>Health Index</b>		

Health Index Templates

Asset	Location	Status
Asset 1	Location 1	Operational
Asset 2	Location 2	Operational
Asset 3	Location 3	Operational
Asset 4	Location 4	Operational
Asset 5	Location 5	Operational
Asset 6	Location 6	Operational
Asset 7	Location 7	Operational
Asset 8	Location 8	Operational
Asset 9	Location 9	Operational
Asset 10	Location 10	Operational



Advanced Anomaly Detection Templates

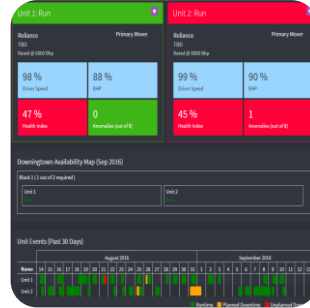
TransCanada Smart OT Infrastructure (illustrative)



# Real-time Analytics – Multiple Layers of Contextual Information



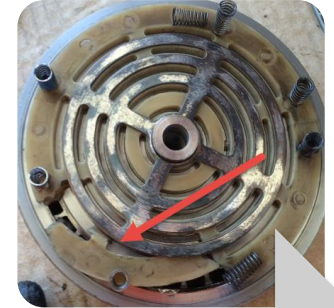
Executive Dashboards  
Visibility  
Situational awareness



Drill into the Problem  
Multiple layers  
of information



Data Analysis  
Ad-hoc trending  
Model training



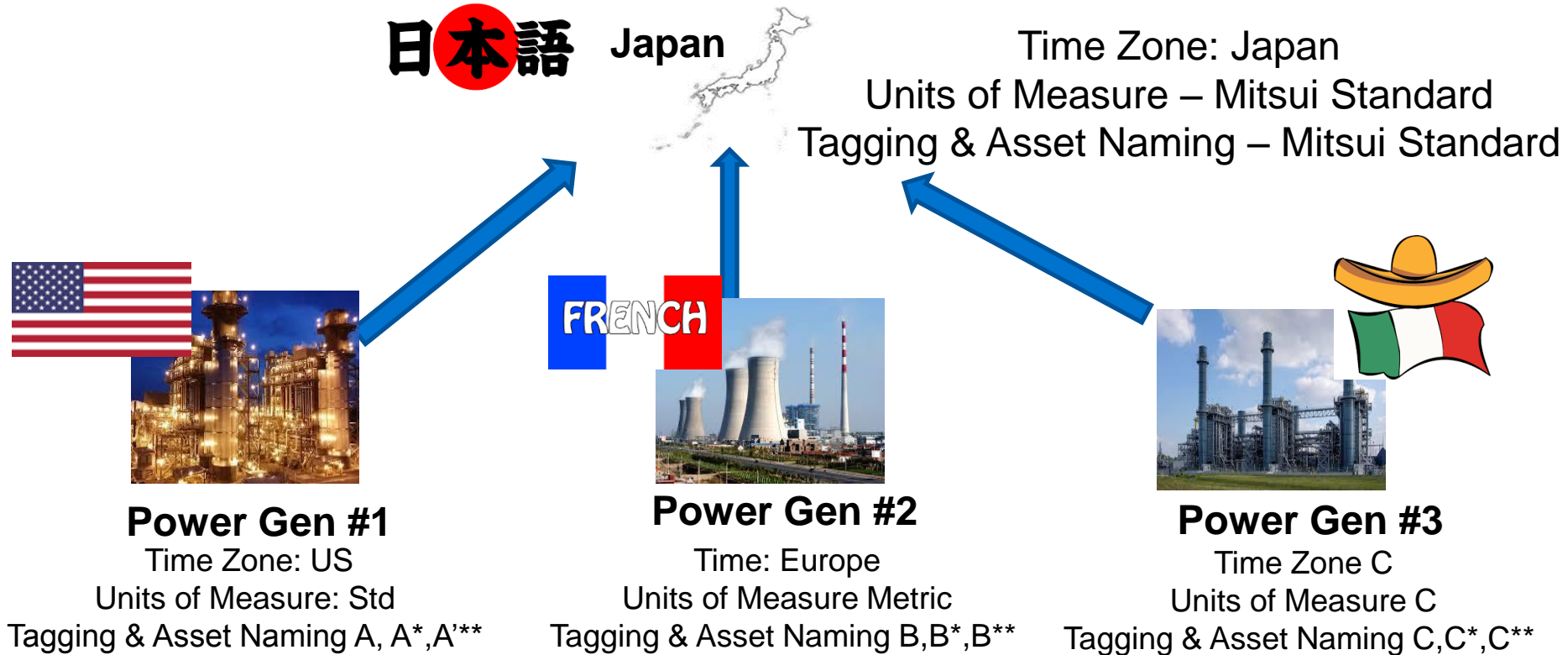
Take Action, Track  
& Document

Asset Name	Unit	Duration	Status	Scope	Byes
Compressor/Dewarhead/010001/Compressor Service	01	16 hours	Warning	Strong	Not Tracked
Compressor/01010001/Driver/GP Bearing Observations	01	6.3 hours	Warning	Flat	Outside Tolerance
Compressor/Dewarhead/010001/Driver Exhaust Temperature	01	34.4 hours	Cleared/OK	Good	Not Tracked
Compressor/Larkham/010001/Driver/Bearing Temperature	01	12.3 hours	Warning	Flat	Not Tracked
Compressor/Kerwood/010001/Compressor/Bearing Temperature	01	57.4 hours	Warning	Flat	Not Tracked
Compressor/Larkham/010001/Driver/Cooling & Lubrication	01	11.6 hours	Warning	Flat	Not Tracked



Time	Assigned to	Action	Comment
Sep 13, 2016 8:37:31 AM	Buddy Childers	Assigned	Bearing 02 Temp A & Bearing 03 Temp A, values criss-crossed suddenly

# PI AF is an “Abstraction Layer” – a Translator



# #4

**They rationalized & distributed what & where analytics were performed**

**..with an eye for the future – from the edge to the cloud...to the “community”**

# Data Infrastructure for Digital Transformation



IIoT



**BIG DATA**

**OSIsoft.**  
PI System Smart OT Infrastructure  
From the edge to the cloud

Rationalized & Distributed Analytics from the edge to the cloud

**SMART OT Infrastructure**

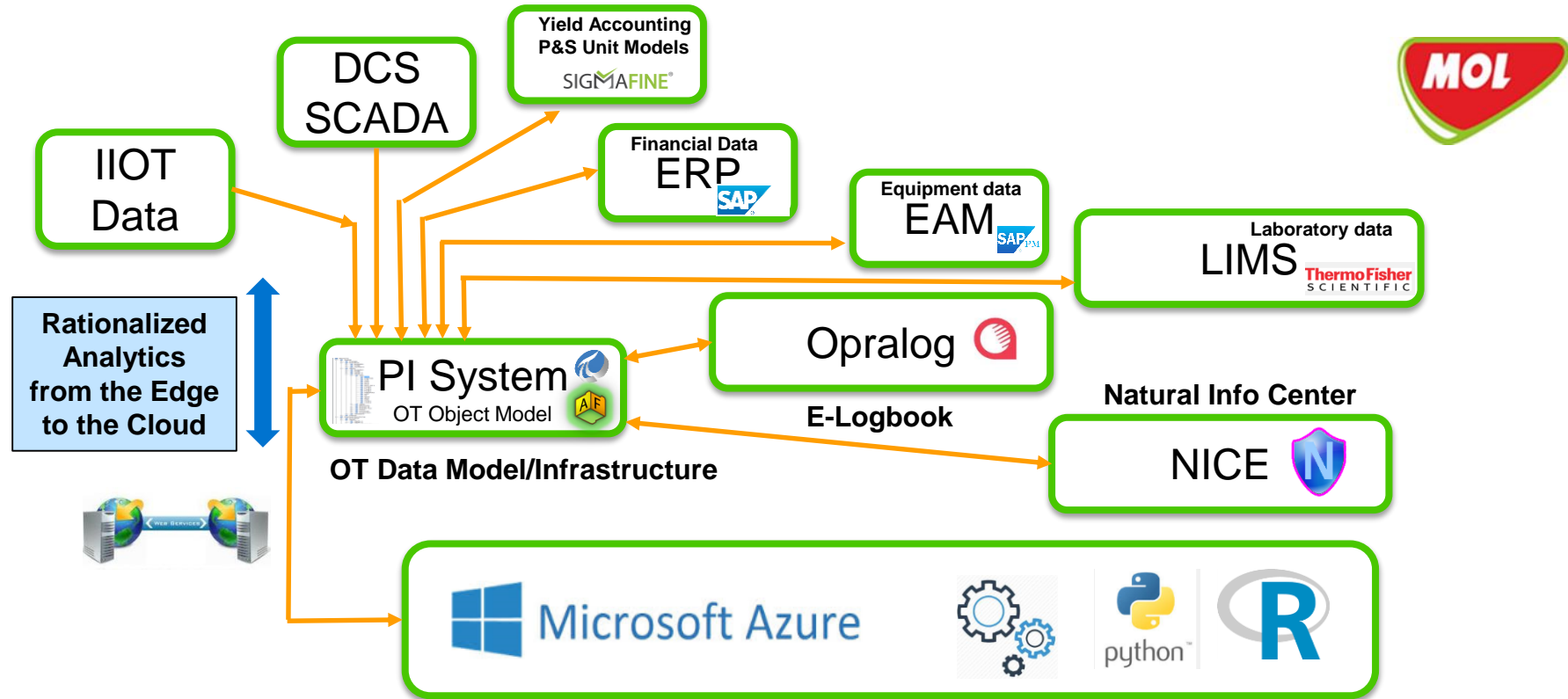
**SMART Plant & Systems**

**SMART MACHINES**

**SMART DEVICES**



# PI AF- the Foundation of MOL's Distributed Analytics



# Natural Gas Consumption Prediction



## BackGround

- Huge saving possibilities in the decrease of contracted natural gas daily maximum amount

## Problem

- High penalty on daily amount exceedance
- Alerting system was needed

## Solution

- Consumption prediction calculations in PI Analysis
- Detailed information on PI Coresight display (about consumption, prediction, contacts of decision makers)
- E-mail alerting system in Notifications

The screenshot shows the PI Coresight interface. On the left is a tree view of elements, including APC, ARGUS, Control loops DR, Danube Refinery, Energy Consumption Predictions, MOLHU NatGas Cons (with sub-items like DF C3 compressor stop, DF Fuel Oil Burning in BoilerPlant, etc.), Energy KPI System, Flare Monitoring, IOW, Siofok, System, Tanks, Technology DataSheet, Tisza Refinery, Zala Refinery, Element Searches, and Element Search 1. On the right is a table with columns for Name and Value. The table is categorized into: <None>, CoreSight Link (http://molzhibicore/Coresight/#/PBD...), Auxiliary Calculations, Consumption Calculations (Cumulated Daily Consumption: 18723164 MJ, Current Consumption: 1991855,5 MJ/h, Predicted Daily Consumption: 49276016 MJ), Exceedance Calculations (Alert State: 4, HI Limit Exceedance: 0 MJ), and Limits (HI Alert: 59500000 MJ, HHI Alert: 61000000 MJ, LO Alert: 0 MJ, LOLO Alert: 0 MJ).

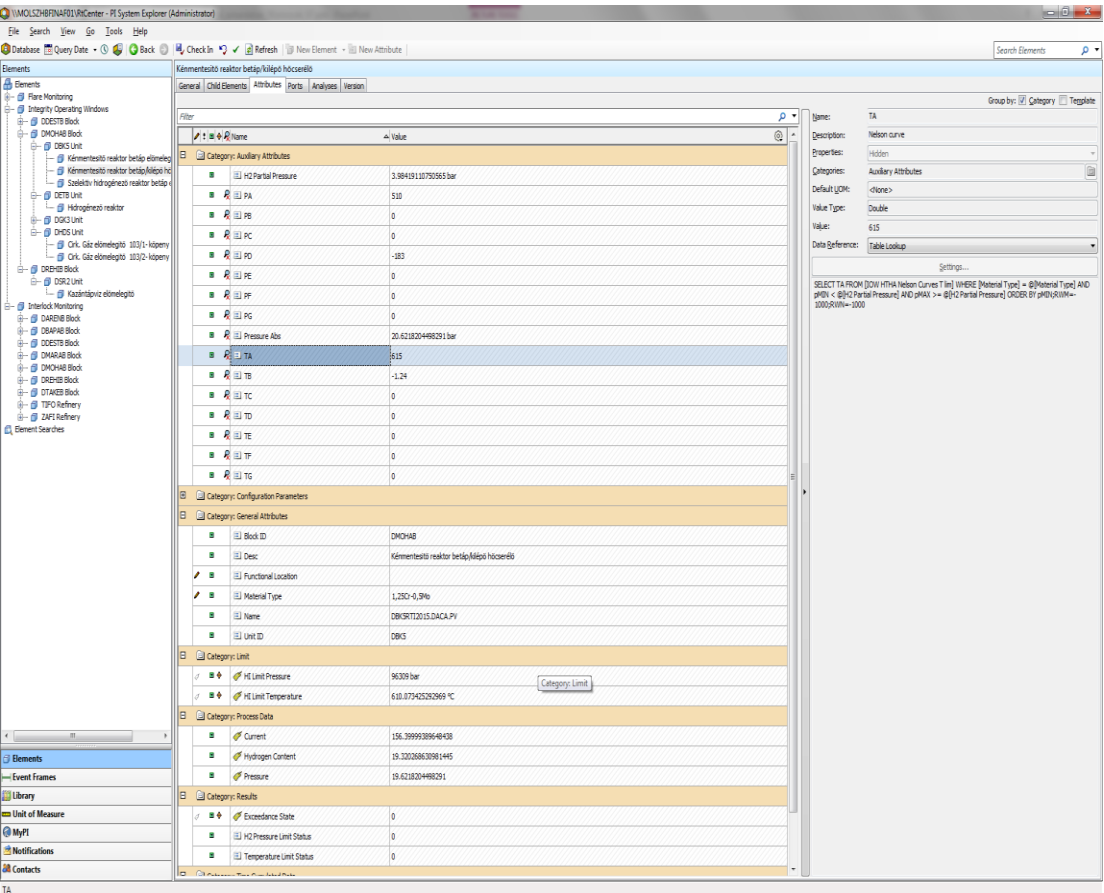
The screenshot shows a detailed view of the configuration and schedule for the consumption calculations. The table has columns for Name, Configuration, Schedule, Output(s), and Backfilling. The rows are: Auxiliary Calculations (RemainingDayRatio := In..., Frequency:=120..., RemainingDayPart; RefD...), CumulatedDailyConsumption (CumulatedDailyConsump..., Frequency:=120..., Cumulated Daily Consum...), CurrentConsumption (CurrentConsumption := T..., Frequency:=120..., Current Consumption), and PredictedDailyConsumption (SecondsToNextGasDayTu..., Frequency:=120..., Predicted Daily Consump...). Below the table is an expression editor with the following content:

Name	Expression
SecondsToNextGasDayTurn	$\text{Int}(\text{Bod}(* * - 6\text{h}^*) + * + 30\text{h}^* - **)$
PredictedDailyConsumption	$\text{Cumulated Daily Consumption} + \text{Current Consumption} * \text{SecondsToNextGasDayTurn} / 3600$

[Add a new expression](#)



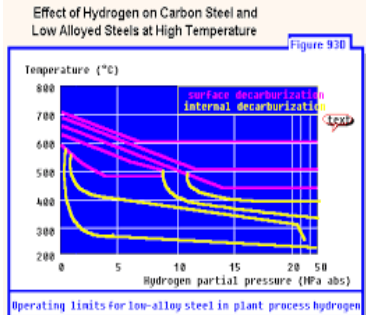
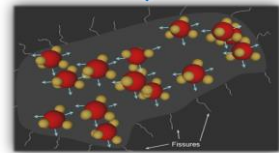
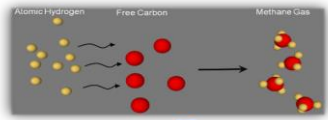
# Improving Asset Integrity with Advanced Corrosion Analytics



- High Temperature Hydrogen Attack (HTHA)
- $f \times$  (metallurgy, temperature, hydrogen partial pressure(PP), length of exposure)

Developed PI AF template that:

- Determine partial pressure
- Attribute of pipe class
- Temperature and length of exposure limits
- Total time above Temp and PP
- Alerts/notification/event frame
- Tested and rolled out in 6 units < 1 week
- All plants in 2015 < 2 months – 50+ nodes



# Enterprise Analytics – Anomaly Detection

## KPI Implementation in AF: Attribute Templates

EC_MaxSpeed	0
_CoeffType	ECMax
A	3.01916
B	0
C	-140.82336
D	0
E	3431.05804
F	0
G	-39811.23565
H	0
I	226037.87046
J	0
K	-524290.83316
L	0
M	0
N	0
O	0
P	0
Q	0
EC_MinSpeed	0
FC_MaxSpeed	0
FC_MinSpeed	0

Lookup curve-fit coefficients from SQL Table  
(performance curves)

Data Reference: Table Lookup

Settings...

```
SELECT CoefficientValue FROM PerformanceCentrifEff WHERE PerformanceModelID = @[PerformanceModelID] AND CoefficientType = @[_CoeffType] AND CoefficientOrder = 1
```

Apply curve-fit to calculate Efficiency

Data Reference: Formula

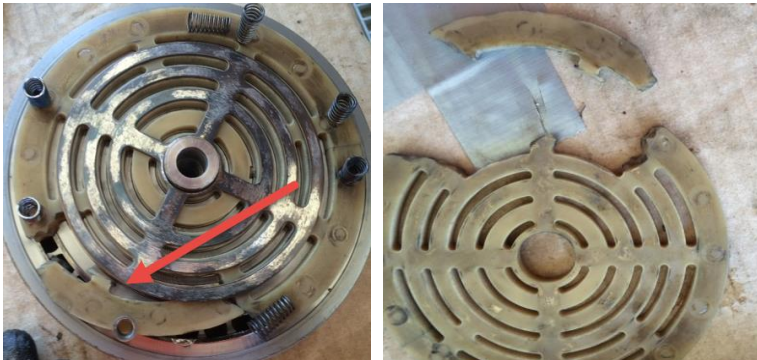
Settings...

```
S=.. \Driver [Steady Speed;A=, |A;B=, |B;C=, |C;D=, |D;E=, |E;F=, |F;G=, |G;H=, |H;I=, |I;J=, |J;K=, |K;L=, |L;M=, |M;N=, |N;O=, |O;P=, |P;Q=, |Q;X=FC_MaxSpeed;[if not(S) then 0 else (A + C*X + E*X^2 + G*X^3 + I*X^4 + K*X^5 + M*X^6 + O*X^7 + Q*X^8)]/( 1 + B*X + D*X^2 + F*X^3 + H*X^4 + J*X^5 + L*X^6 + N*X^7 + P*X^8)]
```



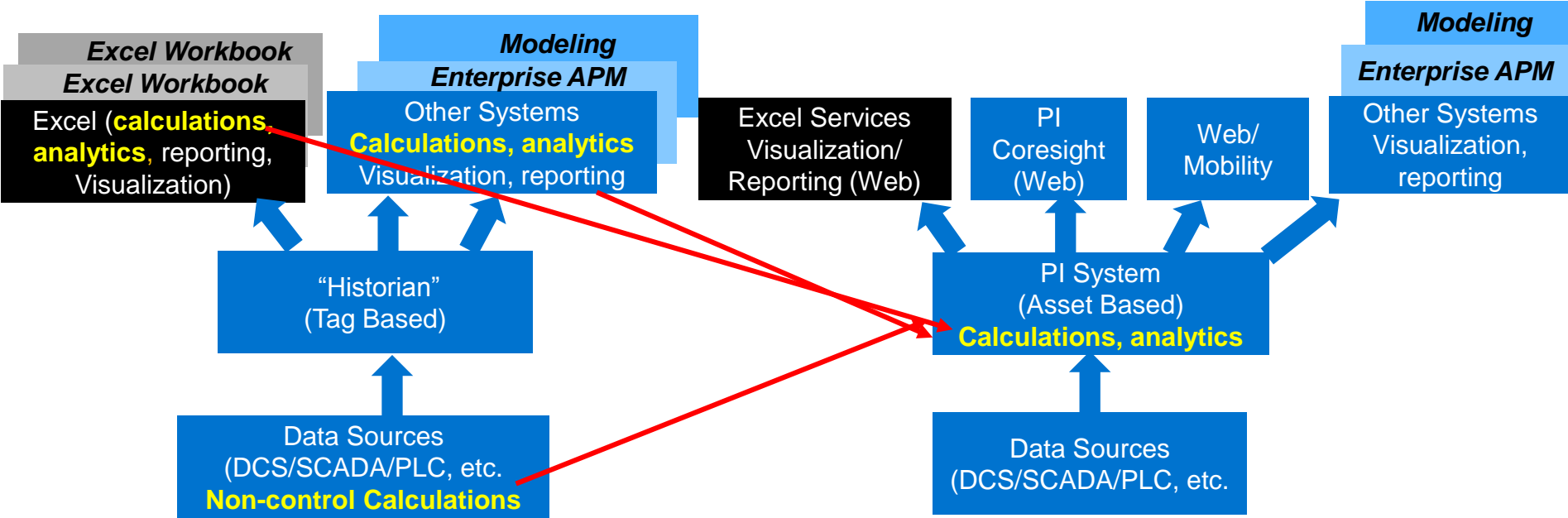
## EA Finding using KPI Strategy

Compression\Houma\Unit01\Gas Compressor\Discharge Temperature\Cylinder 1 Discharge Temperature



Found partially damaged compressor valve.  
The valve was replaced in a planned & controlled manner.

# Perform the calculations/Analytics in the OT Infrastructure



# Advanced APM using the Asset Health Index

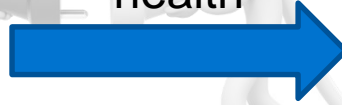


## PI Server

- Process database
- Online analysis of process information
- Calculation of asset health
  - Asset condition
  - Running hours
  - Performance
- User Interface
  - PI Coresight
  - PI DataLink

## Connection (WebLogic)

Calculated asset  
health



Maintenance  
related information

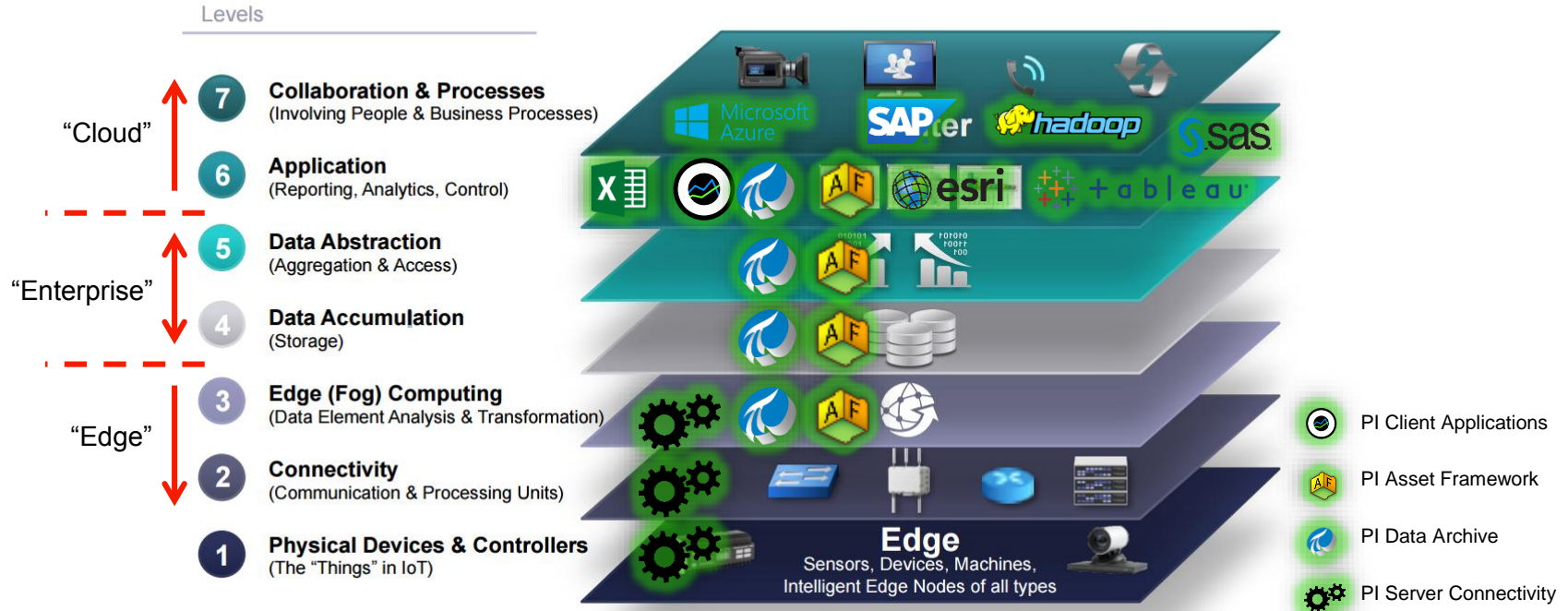


## SAP PM

- Technical database
- Management of maintenance processes
- Creation of work orders or notifications
- Trigger maintenance strategies based on asset health

# PI System in IIoT Reference Architecture

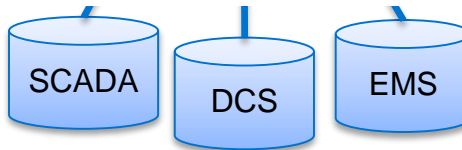
## Internet of Things Reference Model



Presented by Cisco at the IoT World Forum, October, 2014

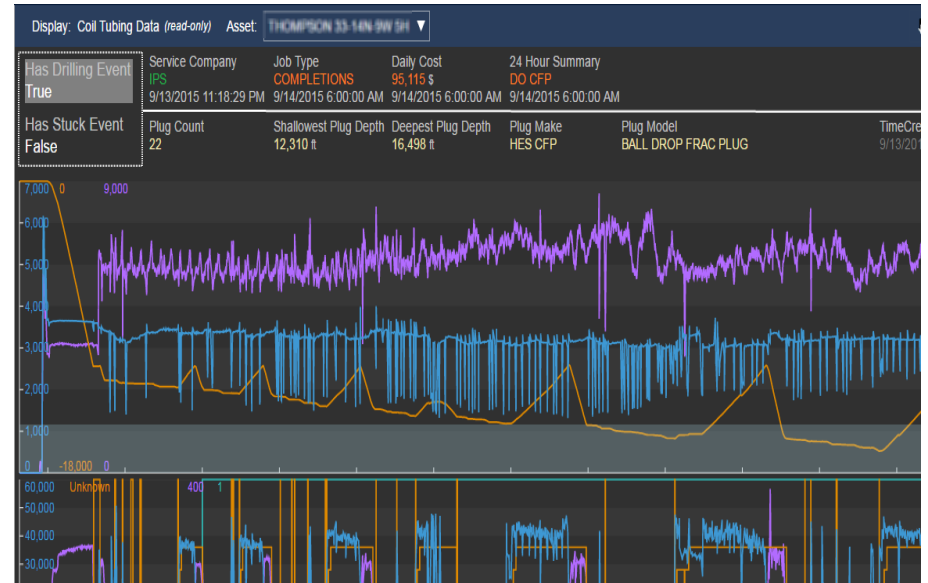
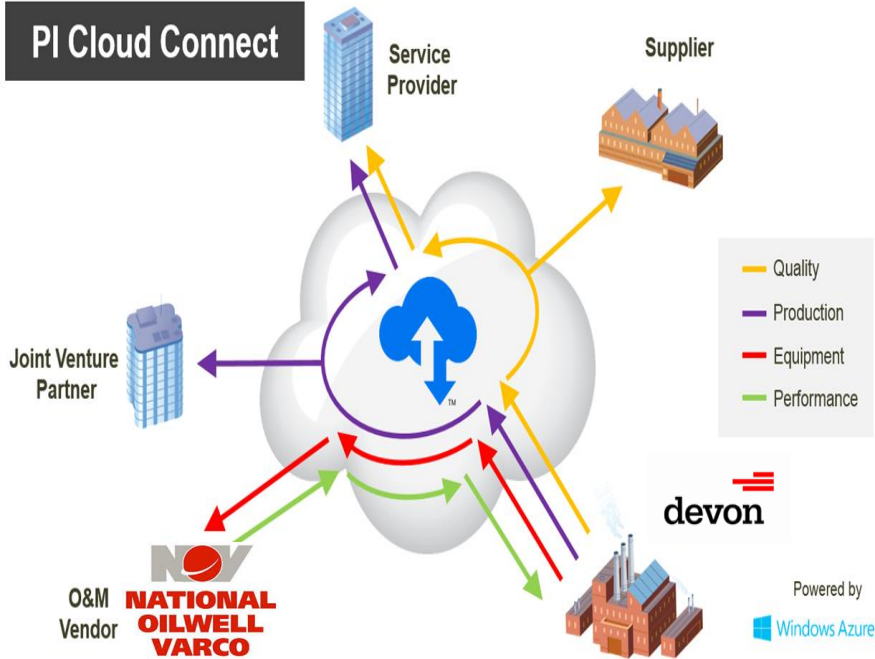
# PI System® IIoT Architecture

Rationalizing & Distributing Analytics



# Devon Energy & NOV - Coil Tubing Analysis

PI Cloud Connect



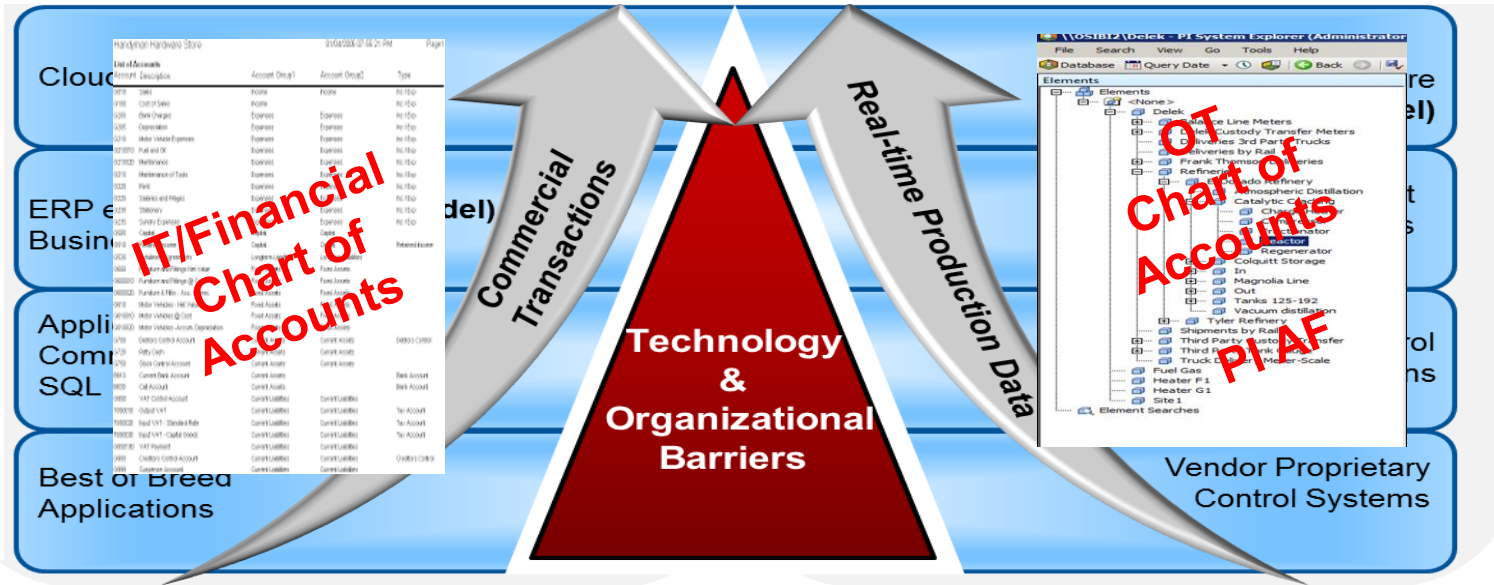
## Community Model

# #5

**They leveraged the smart OT Infrastructure  
to redefine the IT/OT relationship**

**...with the objective of  
unification of the “Ts” around delivering  
transformative business value**

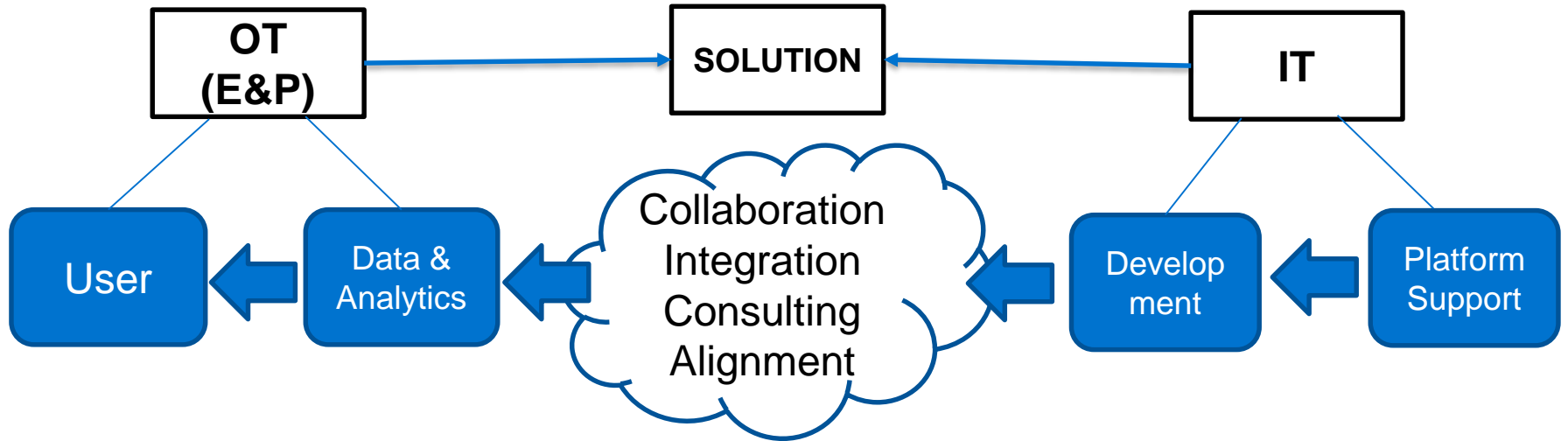
# “OT Chart of Accounts” or “OT Data Object Model”





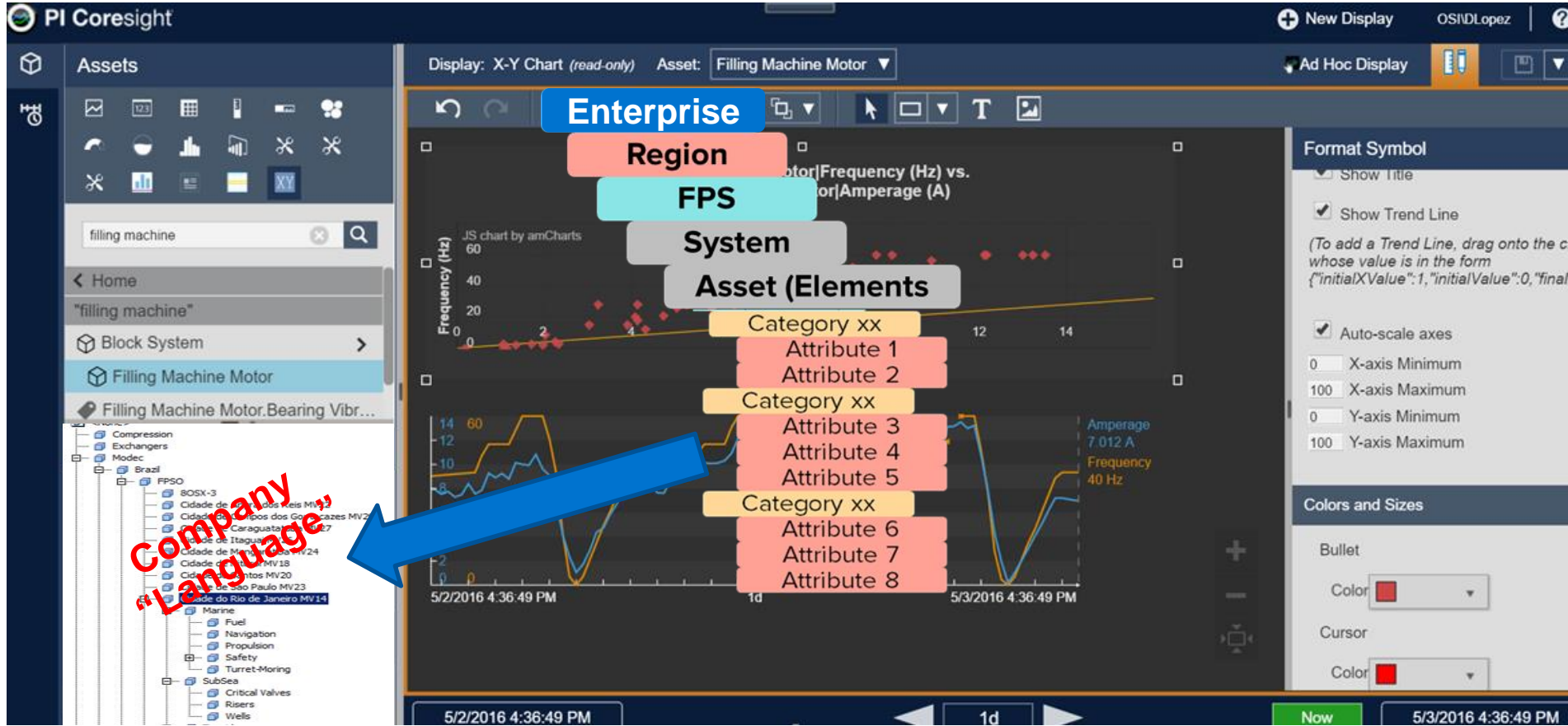
# Devon's Digital Transformation

Our Organization- A "Partnership" between OT & IT

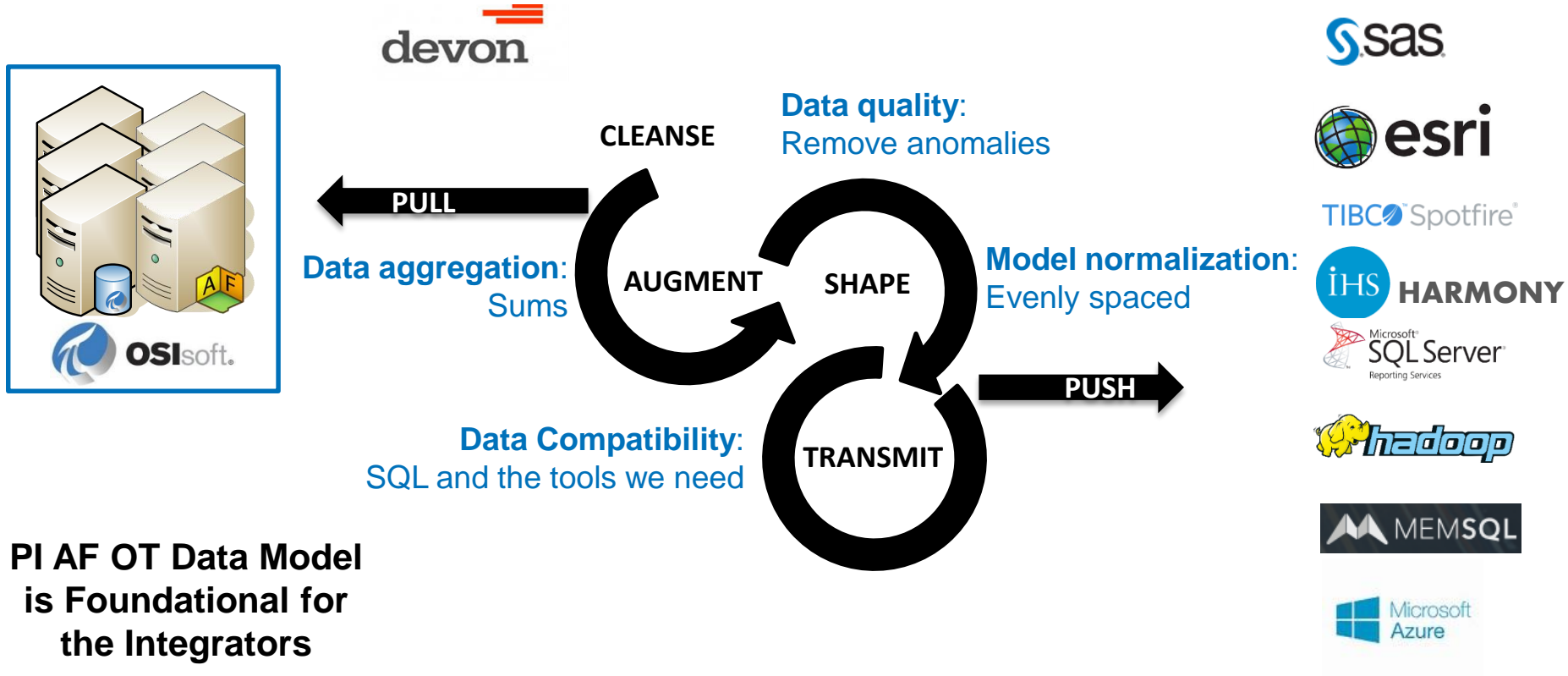


“Devon’s Secret Sauce - OT Owns the smart OT Infrastructure, IT owns the platform – collaborative partnership” Quote from Rick Howell, OSIsoft IIOT. Advanced Analytics, and Big Data Forum Oct, 2016

# Self Serve BI by Leveraging the Smart OT Infrastructure



# PI Integrator for Business Analytics – Self Service BI












PI AF OT Data Model  
is Foundational for  
the Integrators

# Prescription to Transformative Business Value

- 1. Focus accelerating of business value;**
- 2. Create a smart OT infrastructure as a foundation for ALL analytics;**
- 3. Create smart asset object templates;**
- 4. Rationalize & distribute analytics;**
- 5. Partnerships between OT & IT;**

# A Big Thank You to our Speakers!

Time Slot	Company(s)	Title
9:00 - 9:30	 OSIsoft.	“Smart”, Configurable OT Infrastructure
9:45 -10:15	 EQT Midstream	Enabling Reliability Centered Maintenance
10:45 – 11:15		Blowout Preventer Monitoring
11:30 – 12:15	 noble energy	Corporate PI AF + Geospatial Analytics
12:15 –2:15	 OSIsoft.	Lunch – Midstream Users Group Kick Off
2:15 – 2:45		Real-Time Operations on Shell Prelude FLNG
3:00 – 3:30	 Chevron	CBM and Smart Monitoring on the Frade FPSO
4:00 – 4:45	 MOL	Opportunity Crudes/IOW & Advanced Analytics
4:45 – 5:15	 devon	Enabling the Journey of Operational Excellence

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谢谢

Danke

Merci

Gracias

Thank You

Köszönöm

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Спасибо

Obrigado

“In God we trust; all others bring data.”

*W. E. Deming*